THE 1953 LEMMING EMIGRATION AT POINT BARROW, ALASKA

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DURING the summers of 1950 to 1954 the writer studied the ecology of the brown lemming, *Lemmus trimucronatus* (Richardson), at the Arctic Research Laboratory, Point Barrow, Alaska.[1] Field work was begun one year after the mass die-off of 1949, described by Rausch (1950). The first indication of recovery in the lemming population from the 1949 die-off was evident in August 1951, when a phase of proliferation began which continued into 1952 and 1953. Early in June 1953 the onset of a phase of declining lemming numbers was marked by a mass movement that attracted brief but widespread notice. The present paper describes certain biological characteristics of this interesting population phenomenon.

When I arrived at Barrow in mid-May 1953, the tundra was covered with snow about 11 inches deep. Air temperatures varied from 15° to 19°F and essentially winter conditions prevailed until the end of May. Several hundred snap-traps were set under the snow in May to obtain lemmings. Signs of lemmings, clippings and droppings, were found on almost every square foot of the tundra. Most of the snow mantle had been undercut by a network of ground-surface tunnels made by lemmings looking for food (Fig. 1). Later measurements determined that lemmings had clipped over 99 per cent of the standing vegetation.

On May 31 air temperatures rose to 35°F and the snow mantle began to melt rapidly. Prior to this thaw, individual lemmings had made very brief appearances only on the surface of the snow. During the first days of June, however, lemmings began to make prolonged excursions over the snow surface. On June 3 wandering lemmings appeared in the broad gravel streets of Barrow base camp, which stretches for one-half mile along the shore of the Arctic Ocean. Their appearance aroused much interest among the oil exploration workers, who had never seen lemmings behaving like this before. Lemming activity on the surface of the snow increased the next day, June 4, and it was apparent that there was mass unrest in the population. Lemmings could be seen scurrying about on the snow surface in all habitats; they continued to appear in the camp streets, and many wandered beyond the camp on to the arctic ice pack that was grounded along the shoreline.

In order to follow changes in the density of wandering lemmings, a daily search of the Barrow camp, an 80-acre area, was begun on June 6. Each day

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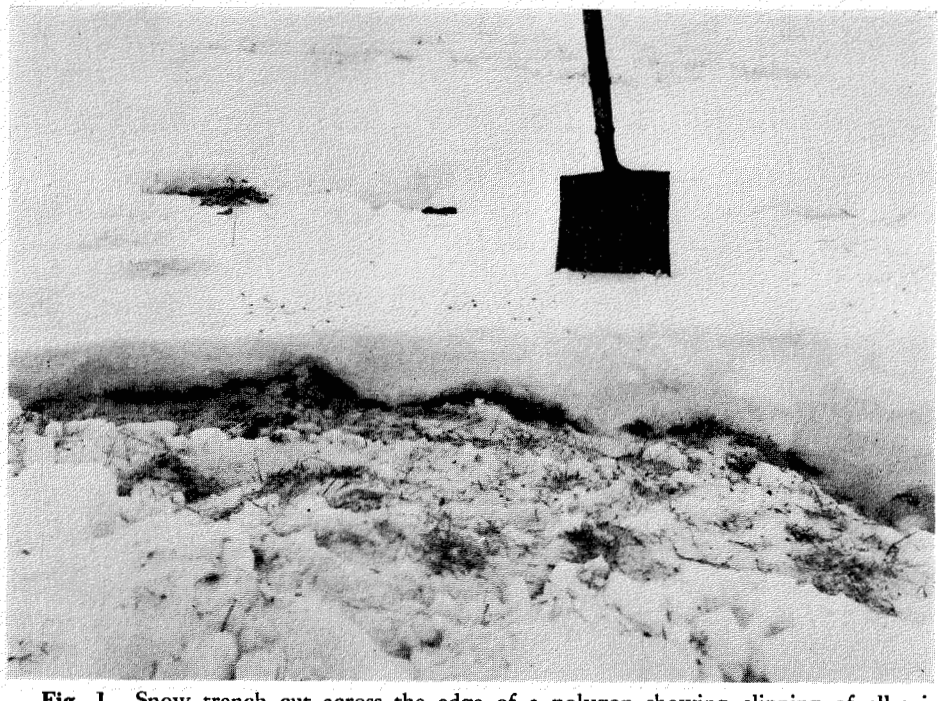

Fig. 1. Snow trench cut across the edge of a polygon showing clipping of all winter forage by brown lemmings. Erect stems in background are dead material which has not been clipped. 19 May 1953.

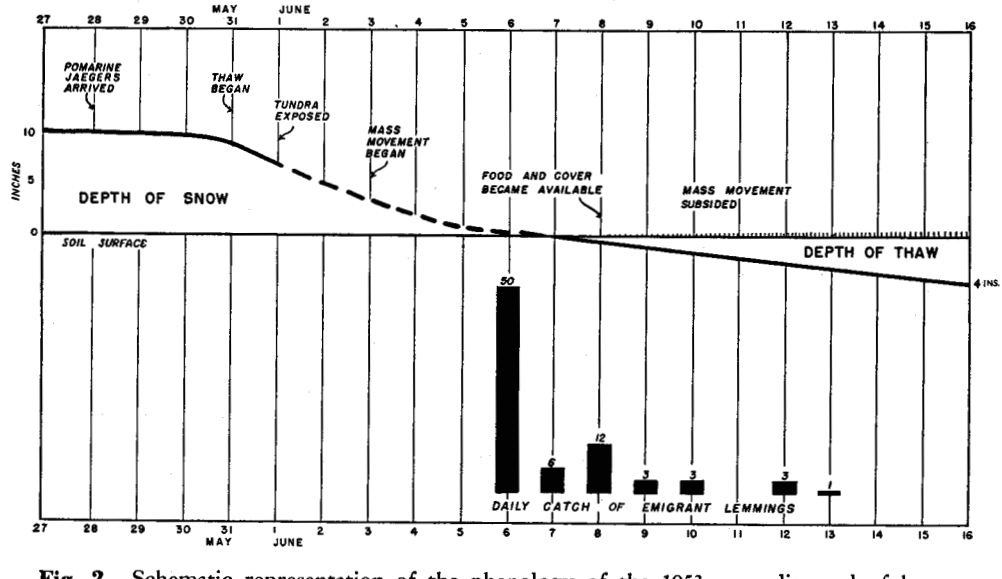

Fig. 2. Schematic representation of the phenology of the 1953 mass dispersal of brown lemmings at Point Barrow.

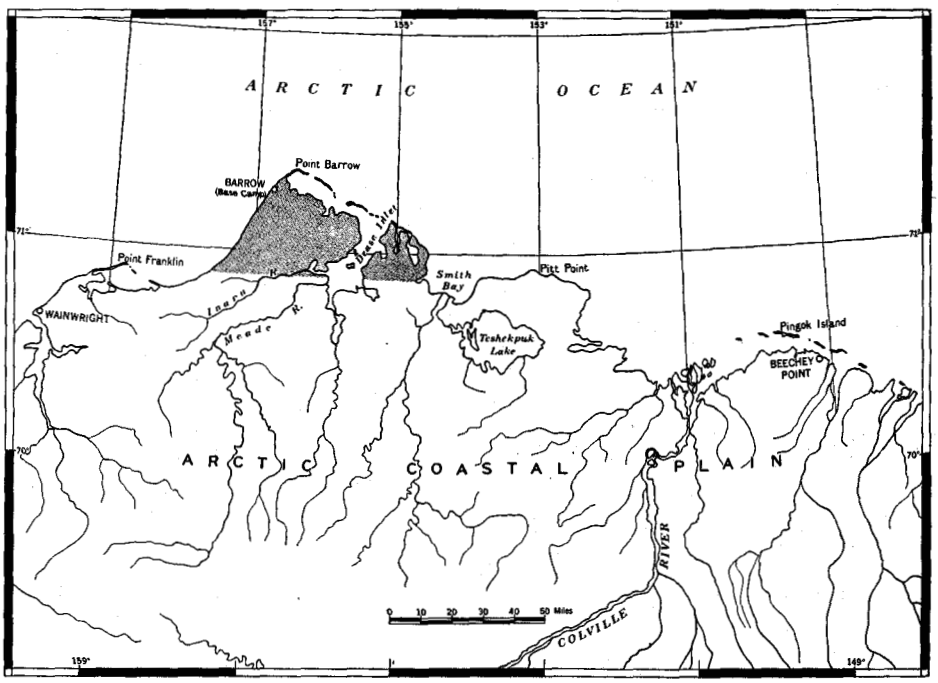

Fig. 3. Area of abundance of brown lemmings in 1953 shown by stipple.

all lemmings sighted throughout the camp were promptly pursued and, with few exceptions, captured. Each evening a careful search was made for lemmings which had sought cover under fuel drums, heavy equipment, and construction materials in storage on the dry, gravel-surfaced camp area. Since an unknown number of lemmings doubtless moved through the camp without being detected, the results only indicate the approximate magnitude of emigration from the adjacent tundra, but observations on the rate of movement of individual lemmings in the camp area suggest that at least two-thirds of those entering the area were captured (Fig. 2). The taking of 50 lemmings on June 6 does not indicate a great influx on that particular day; rather, this striking number represents an accumulation of lemmings throughout the camp area from June 3 to June 6, when the first special effort was made to capture them. The greater part of the movement occurred over a period of five days, June 4 to June 8, during which 73 lemmings were taken on the 80-acre area, an average of nearly one lemming per acre. The average daily catch was one per 5 acres. Wandering lemmings were seen daily in the camp streets until June 13, but by then the period of maximum movement had passed. A few emigrants entered camp in the last two weeks of June, and the last lemming was captured in camp on July 1.

It should be emphasized that the mass movement did not resemble the spectacular migrations reported from Scandinavia (Elton, 1942, p. 213). The lemmings appeared to be engaged in a haphazard dispersal or shuffle, in which

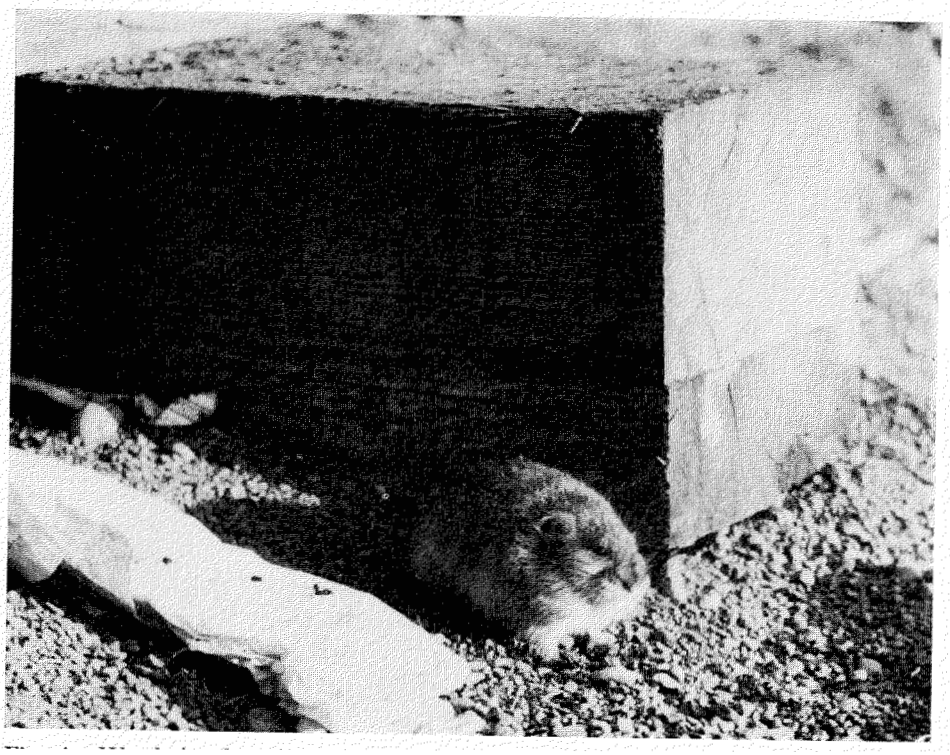

Fig. 4. Wandering lemming which had taken up temporary residence under a pile of construction material in the camp area. The erect pelage and rounded body form are typical of lemmings suffering from malnutrition and exposure. 5 June 1953.

only a small and peripheral part of the population pushed on to the ocean ice. On several occasions, I reconnoitred the ice hoping to find a concentration of lemmings that would make mass collecting feasible, but densities of moving animals were too low to encourage efforts to obtain an adequate sample for population analysis.

Reports from field observers indicated that the area of movement was confined to the northern tip of the coastal plain. Wandering lemmings were reported as far as 10 miles out on the ocean ice on a front extending approximately 30 miles southwest and southeast along the coast from Point Barrow. I made a reconnaissance in July and found from a range survey that the area in which lemmings had reached a peak abundance extended 30 miles inland from Point Barrow to the vicinity of the Inaru River (Fig. 3).

Behaviour of emigrant lemmings

From June 3 to 8, in nine periods of 15 to 20 minutes each throughout the day, individual lemmings moving on the surface of the snow were watched to determine whether their travel was oriented. In every instance the pattern of movement was erratic; some lemmings moved in large circles, some moved in all directions, and others retreated to the point of origin.

Fifteen of the wandering lemmings were captured and caged at the Arctic Research Laboratory for observation. These captives were no more aggressive than dozens of others studied in the previous three years; indeed, they were socially tolerant to the extent of huddling together for warmth.

The lemmings that wandered into the camp area showed a normal tendency to occupy a home range. They took up temporary residence under a pile of lumber (Fig. 4) or other protective cover and could be seen near this cover for several days. One such transient established himself under a stockpile of steel pipe, eluding my attempts to capture him for four days. During this period his only apparent food was an old orange peel and the carcass of another wanderer. Cannibalism was common among wandering lemmings in the sense that live ones fed on the carcasses of those killed by camp vehicles.

Comparison of emigrant and tundra[1] lemmings

To compare the density of lemmings in the camp area with that on the tundra, animals on a series of 60 census plots were counted during the period of mass movement. In the most representative type of tundra habitat, an average of 42 lemmings per acre was captured. This contrasts sharply with the total catch of one lemming per acre in the camp area, indicating that the wanderers represented but a small fraction of the tundra population.

The following table shows the comparison between some characteristics of the wandering and the tundra animals. Approximately 4 out of every 5 wandering lemmings captured in the camp or on the ocean ice were males

Table 1. Comparison of wandering lemmings with those captured at random on the tundra. Body, adrenal, and testis weights are reduced to a body length of 100 mm.

	Wandering lemmings	*Sample*	*Tundra lemmings*	*Sample*
Sex ratio	374 ♂♂/100 ♀♀	90	112 ♂♂/100 ♀♀	458
Age ratio	10 juv./100 ad.	90	18 juv./100 ad.	458
Body weight (males only)	43 gm./100 mm.	36	49 gm./100 mm.	43
Adrenal weight (males only)	9.3 mg./100 mm.	15	8.6 mg./100 mm.	9
Greatest diam. of uterine horn	1.2 mm.	12	2.0 mm.	35
Testis weight	212 mg./100 mm.	24	253 mg./100 mm.	31

whereas the sex ratio was approximately one to one on the tundra. It seems that there were relatively fewer juveniles[2] among the emigrant population; however, this difference is not significant when tested by the chi-square method. The animals in which the body weight, adrenal weight, diameter of uterine horn, and testis weight were measured were taken at random from the same size classes, and were captured on the same dates. Comparison of

[1]The "tundra" lemmings were captured one mile inland. Dispersal and changes of habitat were probably occurring when the sample was taken.

[2]Lemmings below 120 mm. in various stages of juvenile pelage are called juveniles; lemmings measuring 120 mm. or more are designated as adults.

body-weight with body-length indicates that the wanderers weighed approximately 20 per cent less than lemmings on the tundra. Empty alimentary tracts probably accounted for much of this difference, for the emigrants carried a normal amount of subcutaneous fat. Heavier adrenal gland weights are indicated for wandering lemmings, but the difference is not significant.[1] The summer reproductive season had begun at the time of the mass dispersal. Pregnancies were not yet visible in the females; therefore the diameter of the uterine horn was used as an indicator of reproductive activity. These measurements show that the uterine horn diameters of emigrant females were smaller than those of females of the same mean total length captured on the tundra over the same span of days. Likewise, the testis weights of emigrant males were considerably less than those of comparable tundra males. The differences between body weight, testis weight, and uterine horn size of the wandering and tundra lemmings were so great that they could be expected to differ this much by chance alone less than two times out of a hundred;[2] they can therefore be considered real differences.

Causes of emigration

Changes in available food and cover were the only factors that could be correlated with the beginning and end of mass unrest in the lemming population. As the snow mantle melted and the winter tunnels collapsed, the lemmings were forced to venture on to the scattered bare patches of tundra (Fig. 5), and were pitilessly exposed to weather and to avian predators; the newly uncovered tundra was still frozen, preventing the lemmings from using old burrows or forming new tunnels in the surface vegetation. By June 10 only ten per cent of the snow cover remained; the rest of the tundra had thawed sufficiently to allow the lemmings to use old burrows which were free of water, and to make new tunnels in the moss carpet which underlies the standing vegetation (Fig. 6). In addition more forage was available as the moss carpet thawed, and the lemmings were able to dig out the crowns of grasses and sedges (chiefly *Dupontia*, *Eriophorum*, and *Carex* spp.) which had previously been frozen in the sod. The growing season was also underway and each day added a millimetre of new growth to the grasses and sedges. By June 13 the surface thaw averaged three inches on hummocks and one inch in polygonal depressions, and the height of new green growth averaged five millimetres in the depressions. The lemming movement had subsided.

As a means for relieving population pressure, the mass dispersal would seem to have had only a minor effect. Mortality from predators was a far more potent mechanism of population control. This was emphasized by the fact that an average of 11 dead lemmings per acre was found in 30 sample plots on the tundra.

[1] $t=.0349$; $P=>.90$.

[2] Body weight, $t=3.104$, $P=<.01$; testis weight, $t=2.426$, $P=<.02$; uterine horn size, $t=3.125$, $P=<.01$.

Fig. 5. Appearance of coastal tundra during the peak of the mass lemming movement of 1953. 5 June 1953.

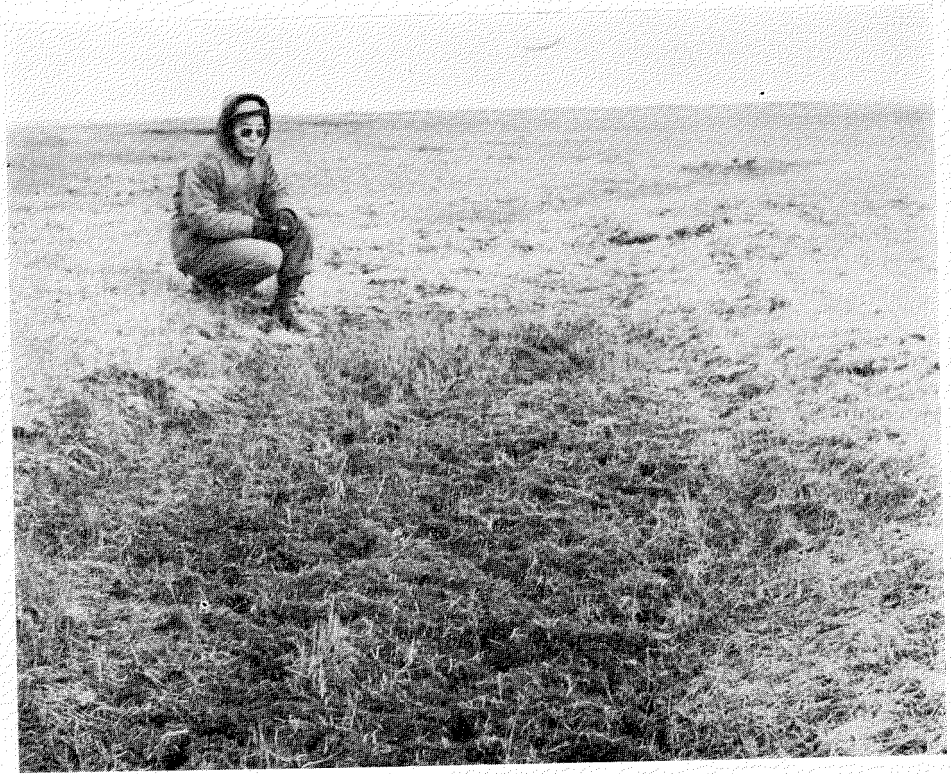

Fig. 6. Surface tunnels thrown up in moss carpet in trough of polygon. 26 August 1953.

Frequency of emigration

Clarke (1940, p. 69) and Elton (1942, p. 469) reviewed the records of the emigrations of collared (*Dicrostonyx*) and brown lemmings in the Canadian Arctic. More recently, Gavin (1945, pp. 229–30) reported an emigration of brown lemmings at the mouth of the Perry River in early May 1937. He noted that the movement continued for ten days and nights in an easterly direction, and estimated densities of one lemming per square yard. Gavin also refers to an earlier mass movement–southward–which he witnessed on King William Island in 1934; he considers this movement to be of a much lesser magnitude than that at Perry River in 1937. Clarke (1940, p. 69) and Elton (1942, p. 469) point out that although emigrations are associated with peaks in population, the number of emigrations are few in comparison to the records of peak abundance.

The situation seems to be much the same in the Alaskan Arctic. Brower (1942, p. 123) recalls a mass movement of great proportions at Point Barrow in late May 1888. He describes the tundra as being black with lemmings coming from the southeast and moving seaward on a 10-mile front; the main body took four days to pass the whaling station. Harmon Helmerick (J. W. Bee, personal communication) saw lemmings on the Arctic Ocean ice 10 miles north of Pingok Island (near Beechey Point) in April and May 1946. This is an interesting observation, since it coincides with the peak lemming year of 1946 at Point Barrow. Stuck (1920, p. 227), describing lemming movements in the Alaskan interior, writes of a mass of floating, dead, brown lemmings in the Yukon River about 10 miles from the Canadian boundary in 1918. Stuck's trail companion, Walter Howard, had seen a similar movement in earlier years.

On the Alaskan Arctic Slope the lemming is of no direct importance in the native economy and therefore receives little attention from the local Eskimo. Nevertheless, recollections of five reliable native observers, whom I interviewed, were in substantial agreement that mass movements, such as that of June 1953, have occurred slightly more often than once each decade. That is to say, Eskimo in middle age recalled having seen two or three such spring movements in the past two decades. One of these observers had lived inland for many years and remembered a movement of brown lemmings in autumn.

In comparison with the brown lemmings in arctic Alaska, the emigrations of the Norway lemming (*Lemmus lemmus*) in Scandinavia (Collett, 1895; Elton, 1942; Wildhagen, 1952) and Finnish Lapland (Pleske, 1884; Kalela, 1949) are much longer in duration, more frequent in occurrence, and involve greater densities of moving animals. The migrations of the Norway lemmings are also more uniformly oriented as to direction of travel and involve greater distances.

Several possible explanations can be found for these differences. First, there is great contrast in the topography of the two ranges. The lemming range in Norway is a high plateau which is intricately dissected by valleys and fiords. As Elton (1942, p. 216) and others suggest, any lemmings moving

over this terrain would soon be trapped in one of these valleys and funnelled into the fiords. The arctic coastal plain at Barrow, on the other hand, is a flat shelf which scarcely rises above sea level, and would have no appreciable effect in orienting the movements of a wandering animal population. Secondly, the habitats within the two lemming ranges are quite different. The Alaskan arctic coastal plain is a monotonous expanse of grass, sedge, and lichen; in contrast the northern European range is a patchwork of altitudinally zoned vegetation in which the subalpine zone is the preferred lemming range. Thirdly, innate differences in the behaviour of the two lemmings exist. For example, the Norway lemming is nocturnal (Collett, 1895), whereas the brown lemming at Point Barrow is active at all hours from June until September. This may be of no particular significance as regards the inclination to emigrate, but it does suggest rather sharp behaviour differences between the two species.

Kalela (1949) regarded the "migrations" of the lemmings in Finnish Lapland as a peripheral manifestation of a much greater internal shuffle within the major lemming range. At Point Barrow during the 1953 mass movement of lemmings, a relatively small fraction only of the tundra population actually wandered out on to the arctic ice pack. It seems that these peripheral movements may also indicate an extensive internal shuffle within the coastal area. Population pressure was relieved much less by the mass dispersal than by mortality from predators, and the exodus of emigrants dropped off sharply as the surface of the tundra thawed, making food and cover available. In general, mass movements of the brown lemming seem to be less intense and less frequent than those reported for the Norway lemming in northern Europe.

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